



Short Note

Association of Physiological Parameters with Yield in Double and Single Cross Derivatives of Upland Cotton *Gossypium hirsutum* L.

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Correlation and path analysis were studied in sixty two single cross, forty two double cross and seven three-way cross derivatives in F4/F5 generation of upland cotton *G. hirsutum* L. lines generated from crossing among selected hybrids of the All India Coordinated Cotton Improvement Project. Five physiological characters and yield contributing traits were studied at the Agricultural Research Station, Dharwad. Correlation among physiological traits viz. photosynthetic rate, stomatal conductance, transpiration rate, chlorophyll content and relative water content revealed significant correlation with seed cotton yield. Path analysis among physiological characters showed that the traits photosynthesis rate, stomatal conductance and chlorophyll content revealed high positive direct effect on seed cotton yield whereas, transpiration rate and relative water content revealed direct negative effect on seed cotton yield.

Key words: Character association, *Gossypium hirsutum*, path analysis, physiological characters

Cotton is the most important fibre crop and backbone of textile industry in India. It alone accounts for 70 per cent total fibre consumption in textile sector with approximately 38 per cent of the country's export. India ranks first in area under cotton cultivation with 12.20 m. ha. (AICCIP, 2012). Among the four linted cotton species, upland cotton *Gossypium hirsutum* L. is the predominant species of cotton in the world as well as in India. Varieties and hybrids of *G. hirsutum* L. occupy about 75 per cent area with 85 per cent of cotton production of the country and have played a significant role in achieving self sufficiency in cotton production. However, Indian cotton productivity is quite low i.e., 481.23 kg lint/ha as against world's productivity 754 kg/ha (AICCIP, 2012).

Joshi and Dhavan (1996) observed that within a certain limit, hybridization of more divergent parents is expected to enhance the level of heterosis in hybrids and release of wide range of variability in segregating generations is a pointer to the further use of these newly generated lines. The present investigation was undertaken to study the nature and magnitude of contribution of different physiological characters towards yield in the genetic material comprising of single cross, double cross and three-way cross derived lines under rainfed conditions.

Materials and Methods

The study was conducted in the Agricultural Research Station, University of Agricultural Sciences,

Dharwad, Karnataka. The experimental material comprised of progeny rows in F4 /F5 generation. The material was generated by crossing diverse hybrids identified during the year 2005-06 in the All India Coordinated Cotton Improvement Project trials. The generated material consisted of sixty two single cross, forty two double cross and seven three-way cross derived lines which were planted in augmented design along with five checks replicated in 5 blocks. Uniform spacing of 90 X 20 cm and all standard manurial and cultural treatments were adopted. In each entry, ten plants were randomly selected and observations were recorded for 6 characters viz, seed cotton yield, photosynthetic rate, stomatal conductance, transpiration rate, relative water content, leaf temperature and Relative Water Content (RWC). SPAD (Soil Plant Analytical Development) chlorophyll meter readings were taken with SPAD 502 instrument (Minolta Company Ltd.). It measures the greenness or relative chlorophyll content of leaves. The fourth leaf from the top was taken for observation between 10.00 am and 12.00 noon. The mean of 10 readings per entry was taken and expressed in mg/g fresh weight of leaf. Measurements of photosynthetic rate, stomatal conductance, transpiration rate and leaf temperature were also made on the top fully expanded fourth leaf at 90 days after sowing by using portable photosynthesis system LICOR-Li-6400, USA. These measurements were observed between 10.00 am and 12.00 noon. Photosynthesis was expressed in $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ S}^{-1}$ and transpiration rate was expressed in $\mu\text{mol H}_2\text{O m}^{-2} \text{ S}^{-1}$. Stomatal conductance was expressed in $\mu\text{mol m}^{-2} \text{ S}^{-1}$ and

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leaf temperature was expressed in degree centigrade °C.

Relative water content was estimated following the procedure of Barrs and Weatherly (1962) at 90 days after sowing. Twenty leaf discs of fourth fully expanded leaf from top were collected and weighed on an electronic balance, and fresh weight was determined. The weighed leaf discs were floated in a petri-dish containing distilled water for four hours and subsequently blotted gently and weighed again, which was referred to as the turgid weight. After taking turgid weight, leaf discs were dried at 80°C for 48 hours and dry weight was recorded. The RWC was calculated by the following formula and expressed in percentage.

$$\text{Relative water content \%} = \frac{\frac{\text{Fresh weight g} - \text{Dry weight g}}{\text{Turgid weight g} - \text{Dry weight g}} \times 100}{\text{Dry weight g}}$$

Correlation coefficients among different characters were worked as per Falconer (1981). Phenotypic correlation coefficients were further apportioned into direct and indirect effects by path analysis as suggested by Dewey and Lu (1959).

Results and Discussion

Phenotypic correlation among physio

morphological characters in 115 genotypes of *Gossypium hirsutum* L. at ARS Dharwad during *kharif*, 2010-11 presented in Table 1. Direct and indirect effects of physiological characters on seed cotton yield per plant at phenotypic level in 115 genotypes derived from single and double cross hybrids of *Gossypium hirsutum* L. at ARS Dharwad during *kharif*, 2010-11 presented in Table 2. Phenotypical path diagram of physiomorphological characters presented in Fig. 1.

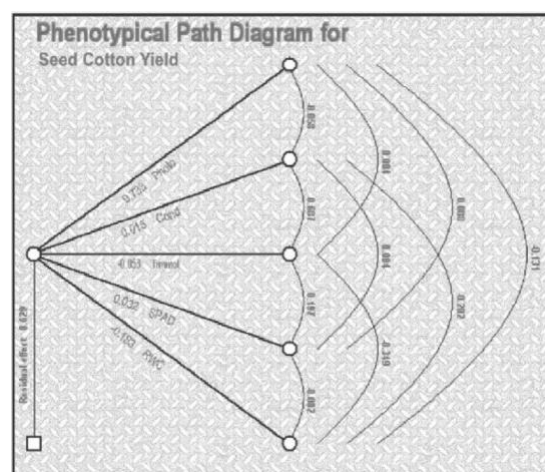


Fig. 1. Phenotypic path diagram for physio morphological characters

Table 1. Phenotypic correlation among physiomorphological characters in 115 genotypes of *Gossypium hirsutum* L. at ARS Dharwad during *kharif*, 2010-11

Characters	Photo synthesis	Stomatal Conductance	Transpiration rate	Temperature of leaf	Chlorophyll content	RWC	Seed cotton yield
Photosynthesis	1	-0.0580*	0.0035	-0.1194	0.0883*	-0.1308	0.7586*
Stomatal Conductance		1	0.6867	-0.0056	0.0041	-0.2020*	-0.0275*
Transpiration rate			1	0.0401	0.1972	-0.3492**	0.0294**
Temperature of leaf				1	0.0989	-0.0932	-0.1161
Chlorophyll content					1	-0.0025	0.0870*
RWC (%)						1	-0.2631*
Seed cotton yield(g/plant)							1

*=Significant at 5% **= Significant at 1%

Association of physiological parameters with seed cotton yield

Photosynthetic rate was positively and significantly correlated with seed cotton yield. Similar observation of positive significant correlation between seed cotton yield and photosynthetic rate was evident with Ashwathama *et al.* (2004), Gopal Krishnan *et al.* (2004) and Janagoudar *et al.* (2004).

Stomatal conductance was negatively and significantly correlated with seed cotton yield. Similar reports were made by Kudachikar and Janagoudar (2004). Transpiration rate revealed strong positive correlation with seed cotton yield per plant. These results were in agreement with those made by Gopal Krishnan *et al.* (2004) and Kudachikar and Janagoudar (2004).

Leaf temperature had non-significant negative correlation with seed cotton yield. This result was similar to the findings of Ravi Naganur *et al.* (2004).

Chlorophyll content of leaf had strong positive correlation with seed cotton yield per plant. Similar results of association of chlorophyll content of leaf with seed cotton yield were made by Ningnanur *et al.* (2004), Ratna Kumari *et al.* (2004a), Kudchikar *et al.* (2004), Janagoudar *et al.* (2004), Gopal Krishnan *et al.* (2004) and Ratna Kumari *et al.* (2004b)

Relative water content expressed strong negative correlation with seed cotton yield. Similar significant negative correlation was observed by Ningnanur *et al.* (2004) and Ratna Kumari *et al.* (2004a).

Table 2. Direct and indirect effects of physiological characters on seed cotton yield per plant at phenotypic level in 115 genotypes derived from single and double cross hybrids of *Gossypium hirsutum* L. at ARS Dharwad during kharif, 2010-11

Characters	Photo synthesis	Stomatal Conductance	Transpiration rate	Chlorophyll content	RWC	Correlation with Seed cotton yield
Photosynthesis	0.7329	-0.0008	-0.0002	0.0029	0.0239	0.7587
Stomatal Conductance	-0.0425	0.0147	-0.0367	0.0001	0.0369	-0.0275
Transpiration rate	0.0026	0.0101	-0.0535	0.0064	0.0639	0.0295
Chlorophyll content	0.0647	0.0001	-0.0105	0.0323	0.0005	0.0871
RWC (%)	-0.0959	-0.0030	0.0187	-0.0001	-0.1829	-0.2632

Residual effect = 0.6285

Path coefficient analysis for physiological characters

Photosynthesis exhibited positive direct effect 0.7329 on seed cotton yield per plant. Selection based on this character would help improve the seed cotton yield. Chlorophyll content (0.0029) and relative water content (0.0239) were showing higher positive indirect effect through photosynthesis. Stomatal conductance had direct positive effect on seed cotton yield (0.0147). Its indirect effect was higher *via* relative water content (0.0369). Negative direct effect of transpiration rate (-0.0535) on seed cotton yield per plant was observed. Further, transpiration rate had a higher indirect effect *via* relative water content (0.0639). The direct effect of chlorophyll content was positive (0.0323) on seed cotton yield. Selection based on this character would improve the seed cotton yield. Karadmir *et al.* 2009 reported positive direct effect of chlorophyll content on seed cotton yield per plant. There was direct negative effect of RWC on seed cotton yield per plant -0.1829. Narisi Reddy and Ratna Kumari (2004) reported negative direct effect of RWC on seed cotton yield.

The traits viz, photosynthesis, stomatal conductance and chlorophyll content revealed high positive direct effect on seed cotton yield. Whereas, transpiration rate and relative water content revealed direct negative effect on seed cotton yield indicating that as in rainfed condition as transpiration increases plant population loses its energy and decreases yield level.

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